# Sample Operating and Safety Procedures

The facility may use this guide as is and fill in the appropriate information that is requested in each section.

OPERATING AND SAFETY PROCEDURES FOR

(name of facility)

The Radiation Safety Officer (RSO) is Dr. _____

The following procedures have been established to minimize radiation exposure to patients and employees. They are provided to comply with rules enforced by the Wisconsin Department of Health and Family Services, Section of Radiation Protection. These rules require that each dental x-ray facility be registered with the Department of Health and Family Services.

## A. Operator Training and Safety

### 1. *Training Requirements for X-Ray Machine Operators*

All new x-ray machine operators must be trained in the safe operation of the x-ray equipment, selection of proper technique from a technique chart, patient radiation protection and proper film processing. Trained staff should sign-off with their name and date of the training on the x-ray equipment on the form in Appendix A.

New x-ray machine operators need to be trained on each piece of x-ray equipment they will be operating. Though they may have operated similar equipment in the past, each unit has some unique operating characteristics. New x-ray machine operators need to acknowledge this training by signing-off on the Appendix A form or similar record.

### 2. *Individual Radiation Monitoring Requirements*

Employees who operate dental x-ray machines are required to be assigned an individual radiation monitoring device (personal dosimeter) ***if*** they are likely to be exposed to 5 mSv (500 mRem) per year. If previous radiation monitoring records show that it is unlikely that a person will be exposed to 5 mSv, then monitoring is not required. Re-testing every five years should be conducted to ensure all employees are following the radiation safety policies. State radiation protection staff inspects all dental offices about every three to four years. During the inspection they can make radiation measurements at the operator positions to determine whether dosimeters will be required.

Changes made to the office configuration such as relocation of x-ray equipment or replacement of one type of equipment with another (pan for intra-oral) may require re-testing with monitors to ensure that adequate operating procedures are in place.

New offices require monitoring of personnel for one year to ensure adequate protection for the operators. Monitoring may be discontinued if the results indicate that no employee is likely to receive 5 mSv in a year.

If monitoring devices are worn, they shall be worn at the neck level or on the upper torso. If a protective apron is worn because the operator needs to be less than six feet from the tube or patient, the monitoring device must be worn at the collar outside the apron. Monitoring devices may be changed every three months rather than each month, so long as no badge wearer exceeds 5 mSv (500 mR) in a year. If any badge wearer exceeds the 5 mSv (500 mR) in a year, all wearers will have to change badges every month until the cause of the high reading is determined.

HFS 157.88 in Subchapter X discusses the requirements for notifying the employee of their monitoring results. Each employee who wears a monitor should be shown the monitor report and acknowledge seeing the results

by initialing the report by their name. Social security numbers may be used for identifying each employee or an employee number may be used for identification in lieu of a social security number.

Records of employee exposure must be retained, even after the employee has left employment at the facility. Upon departure, each employee must receive a copy of their final monitoring report that shows their exposure for the entire employment period. The information on the periodic monitor report may be recorded on facility letterhead and include the phrase "This report is furnished to you under the provisions of Wisconsin Administrative Code, Chapter HFS 157, Radiation Protection. You should retain this report for future reference".

Other staff who do not routinely operate the x-ray equipment do not need to be monitored. Situations may exist where office staff is routinely within 6 feet of the x-ray tube when it is operated. The situation should be evaluated to determine whether staff in those areas need to be monitored.

**3. *Holding of patients and/or film***

a. Holding film in the patient's mouth by the operator shall be avoided. Film holding devices must be used unless there are patient management issues that may require parents, guardians or staff to hold the film in position.

   If someone must hold ~~a~~ film in position, the following precautions must be taken:

   i. Always try to use a remote holding device to stabilize the film position.

   ii. The person holding the film should always wear an apron.

   iii. If the film must be held in position using a finger, always try to have a non-employee hold the film.

   iv. If an employee must hold the film with a finger, the person is limited to 350 such exposures a year. Any more will exceed the permitted occupational exposure to the extremities.

   v. No employee may be assigned the task of holding a film on a regular basis.

b. The tube housing shall not be held during an exposure by any person, either staff or parents. If the tube support assembly is unstable and the tube drifts during an exposure, the unit should be taken out of service and repaired.

**4. *Posting Notices and Instructions to Workers***

a. The "Notice to Employees" form needs to be posted on an employee bulletin board or in a employee accessible area. The notice to employees form applies to all staff, not just the x-ray machine operators.

Employees must read the "Notice to Employees" sign posted in/at (specify location}_____ (The "Notice to Employees" form can be printed from the DHFS web site: http://dhfs.wisconsin.gov/dph_beh/BEH/Xray/index.htm)

b. The certificate of registration, issued by the department annually at the time of x-ray installation registration renewal, the operating and safety procedures and any notices of violations involving radiological working conditions are located in/at (specify location(s))_____.

c. The employee rights and obligations as a radiation worker are found in HFS 157.88. (This may also be printed from the DFHS web site listed above and is located in Subchapter X.)

***5. Occupational Radiation Dose to X-ray Machine Operators***

Occupational dose limits for x-ray machine operators are found in s. HFS 157.22 in Subchapter III. If any x-ray machine operator is pregnant or becomes pregnant, she may voluntarily inform the Radiation Safety Officer

(RSO) or employer in writing of the pregnancy. If the RSO or employer is informed of the pregnancy, the employer must ensure that the dose to the embryo or fetus does not exceed 5 mSv (500 mrem) during the entire pregnancy and no more than 0.5 mSv (50 mrem) in any month. The dose to the monitoring device worn at the waist level is considered to be the fetal dose. Pregnant x-ray machine operators shall be monitored for radiation exposure. If the x-ray machine operator chooses to wear a leaded apron and have dosimetry, two monitors are recommended; one device will be worn at the neck and the second under the apron at the waist level. If an apron is not worn, only one monitor may be assigned and that shall be worn at the waist level.

If a x-ray machine operator does not declare their pregnancy in writing, for radiation safety purposes they are not considered to be pregnant and the 50 mSv (5 Rem) occupational exposure limit applies.

If you suspect there has been an excessive exposure or a radiation incident such as unintentional exposure of yourself or another employee, immediately notify the RSO or employer.

**Top Ten Dosimeter Do's and Don'ts**

- **DO WEAR IT** when working. It has no value in your locker or purse**.**
- **DON'T WEAR IT** when you are receiving x-rays for your own health care.
- **DON'T WEAR IT** away from the workplace**.** Leave your dosimeter in the same place every day when you leave the office so you know where it is.
- **DON'T WEAR IT** under your apron unless you are wearing two dosimeters, one at the neck level outside the apron and one under the apron. This applies to pregnant workers.
- **DO TURN IT IN** on time. Time gaps make analysis more difficult, less accurate and reduces legal and historical value of the reports.
- **DO PLACE** the control dosimeter in a radiation-safe area; the dose to the control is subtracted from each dosimeter and needs to be accurate.
- **DO REPORT LOST OR DAMAGED** dosimeters immediately. Prevent damage by not leaving your dosimeter in areas of high temperature such as your dashboard or in the clothes dryer.
- **DON'T PLACE** a dosimeter in an area for testing of stray radiation. Additional dosimeters can be assigned for testing.
- **DON'T SHARE** dosimeters; this is illegal. An average total for a shared dosimeter is meaningless to each individual.
- **DON'T TAMPER** with your dosimeter or anyone else's. The reports are legal documents and are regarded as real exposures received. Tampering with dosimeters is grounds for dismissal.

***6. Multiple Employers***

If an x-ray machine operator works in more than one facility and wears a dosimeter in each facility, each such employee is responsible for reporting their exposure from each job to each employer. The cumulative exposure from each job is the occupational exposure limit. No x-ray machine operator is allowed to receive more than 50 mSv (5 rem) from all employment during a calendar year.

**B**. ***Patient Safety***

Patient radiation safety practices include:

1. Using the lowest possible radiation exposure for each exam by using the fastest film speed and the shortest exposure time
2. Avoiding repeat x-rays by setting the correct technique
3. Positioning the tube head and film carefully
4. Provide the patient with a leaded apron if requested

***C. X-ray Machine Operations and Film Processing***

1. *X-ray Machine Operator Position during Exposure*

a. The x-ray machine operator must be able to continuously communicate with the patient. The x-ray machine operator position must allow the operator to convey any verbal instructions to the patient.

b. During the exposure, the employee must stand at least six feet from the useful beam or behind a protective barrier and not in the direction that the tube was pointed. (Most employees step into the hallway as drywall provides adequate protection).

2. *Use of a Technique Chart* (See Appendix A for a sample chart)

Technique charts are required for systems with adjustable techniques, such as kV, time or pulses and mA (x-ray tube current). Use of a technique chart aids in reducing the exposure to the employee and patient by providing a standard technique for a given machine regardless of the employee operating the equipment. The chart must be posted near the control panel of each x-ray machine, near the control where the technique is adjusted. If the exposure values can be adjusted from outside the room, then the chart should be posted near the control where the employee adjusts the technique.

3. *X-ray Beam Restriction and Alignment*

Use the beam limiting devices (cone) provided on the x-ray machine. Never take a patient x-ray without a cone on the tube head. Beam limiting devices must meet the requirements of HFS 157.78. The short, black plastic cones are no longer permitted as they allowed too much scatter radiation exposure to the patient. They must be replaced with the shielded, lead lined, cylinder, open-ended cones. (Measurements have shown a scatter reduction to the patient of up to 75 percent by changing to the shielded cone).

Multipurpose units used for intra-oral and cephalometric exams must use the appropriate alignment devices and secure the tube head at the specified distance for proper beam size and alignment.

4. *Use of Mobile or Portable Machines*

a. During the exposure using a mobile or portable x-ray device the x-ray machine operator:

1. Must be positioned so that his/her exposure to scatter radiation is as low as reasonably achievable (ALARA) (e.g. 6 feet or more away) and

2. Should never be in line with the direct beam.

3. If the x-ray machine operator must be closer than 6 feet from the patient, the operator must wear a lead apron.

b. No person may hold the x-ray tube housing during the exposure. A stand or other means of support shall be used during the exposure. There is the possibility of electric shock from improper grounding is the machine is hand-held.

### *D. Film Processing*

**NOTE**: Facilities with digital imaging and no "wet chemistry" processing capability are not required to comply with this section. Endodontic facilities that use "hot" chemistry at the chair side are not required to comply with this section.

**Film Handling and Storage**

1. Unexposed film is stored in a location in each operatory where the useful beam does not strike it.
   a. Film shall ***not*** be stored in lead-lined wood boxes.
   b. Unexposed film is safe in the operatory as long as it is not stored in line with the direct beam of the x-ray tube.

c. Large quantities of unexposed film (more than used in a month) should be stored according to the manufacturer requirements. Film is stored in_____.

(Film may be frozen for long term storage of up to two years. Frozen film should be allowed to thaw at room temperature for at least 24 hours before use).

2. Films shall be developed by the time and temperature recommended by the x-ray film manufacturer. If you are uncertain about the processing, check the film manufacturer's web site or contact the distributor. These specifications are posted in/at (*specify location*)_____(usually in the darkroom or next to the processor).

3. Check the temperature at the beginning of the workday using a thermometer that does not contain mercury. Do not process films unless the developer temperature is at the minimum specified by the manufacturer. Manual processing temperature should be checked throughout the workday. Automatic film processors monitor and adjust the temperature only and do not monitor the chemistry condition. The thermostat in the automatic processor may become inaccurate and not provide proper temperatures. The developer temperature needs to be monitored daily.

4. For automatic processors, run blank films through the processor at the beginning of the workday to clean the transport system if recommended by the manufacturer.

**Processor Quality Control Testing**

Quality control of the processing system is an often over-looked area of radiography yet it is the most critical to consistent, quality images. Processor testing procedures are found in Appendix E, Film Processor Testing Procedures.

1. Expiration dates on film and chemicals should be checked periodically. New film or chemicals should be rotated so the oldest are used first. Do not use films or chemicals after the expiration date. Do not use premix chemistry that is more than 30 days old.

2. Chemicals will be replaced by (specify name of person)_____according to the manufacturer's or chemical supplier's recommended interval, which is (indicate frequency specified in the owners manual)_____, or no longer than one month. One person should be assigned the responsibility to changing the chemistry and cleaning the processor.

3. Lighting in the film processing/loading area is provided under these conditions and should not be changed without authorization from the RSO:

   Filter type on the safe light _____
   Bulb wattage in the safe light _____
   Distance from work surfaces for mounting of the safe light _____feet.

4. If you see light leaks around doors, ceilings, or other openings in the darkroom, notify the RSO.

***E. Film Processing Records***

1. Records of the weekly processor testing do not need to be retained, but the weekly films should be retained until the chemistry is changed and the process starts over.

2. The processor chemistry change and darkroom maintenance log sheet is found in Appendix B. This should be posted in the film processing area.

3. State inspectors will check to se if the processor Quality Control (QC) is being performed but will not expect to see historical records or old films. They will check for current and most recent films.

***Training Opportunities***

X-Ray training classes for dental office personnel may be available through the Wisconsin Dental Association or Marquette University School of Dentistry. Check the web sites for availability of training.
http://www.dental.mu.edu/ and http://www.wda.org

## APPENDIX A

**RECORD FOR INSTRUCTION OF INDIVIDUALS IN OPERATING AND SAFETY PROCEDURES FOR**

*(name of facility)*

X-ray operational and film processing procedures for this dental office have been made available to each individual who operates the x-ray equipment on the date(s) indicated.

**Equipment Employee Statement**:

I have read these procedures and agree to abide by them.

(Signature of Equipment Operator) (Date)

(Signature of Equipment Operator) (Date)

(Signature of Equipment Operator) (Date)

(Signature of Equipment Operator) (Date)

(Signature of Equipment Operator) (Date)

(Signature of Equipment Operator) (Date)

**APPENDIX B**

**SAMPLE DARKROOM REQUIREMENTS LOG FOR CALENDER YEAR**

***Automatic processor (Model #_____, Serial #_____) OR Manual processing***

Developer temperature _____

***Chemicals replaced***

(manufacturer's or chemical supplier's recommendations or every month or when testing determines that the chemistry needs to be replaced)

(initials )_____( date) _____

(initials )_____(date ) _____

(initials)_____(date) _____

(initials)_____(date) _____

(initials)_____(date) _____

(initials)_____(date) _____

(initials)_____(date) _____

(initials)_____(date) _____

(initials)_____(date) _____

(initials)_____(date) _____

(initials)_____(date) _____

(initials)_____(date) _____

***Darkroom light leak tests performed (every 6 months)***

(initials)_____(date) _____

(initials)_____(date) _____

***Lighting checked in film processing/loading area***: **(every 6 months) if the facility has a darkroom.**

Safe light filter type _____
Safe light bulb wattage _____watts
Safe light distance from work surfaces _____inches

(initials)_____(date) _____

(initials)_____(date) _____

***Light leaks or related deficiencies noted every 6 months)***
(initials)_____(date) _____

(initials)_____(date) _____

***Corrections of light leaks or related deficiencies (or attach service/work orders)***

(initials)_____(date) _____

(initials)_____(date) _____

## Appendix C SAMPLE DENTAL TECHNIQUE CHART

**CEPHALOMETRIC**

| PATIENT SIZE | kVp | mA | TIME | Source to Image Distance | FILM/SCREEN Type |
|---|---|---|---|---|---|
| Small | | | | | |
| Medium | | | | | |
| Large | | | | | |

**PANORAMIC**

| PATIENT SIZE | kVp | mA | TIME | Source to Image Distance | FILM/SCREEN Type |
|---|---|---|---|---|---|
| Small | | | | | |
| Medium | | | | | |
| Large | | | | | |

**INTRAORAL**

***ADULT***

| | kVp | mA | TIME | Source to Skin Distance | FILM Type and size |
|---|---|---|---|---|---|
| Anterior Region | | | | | |
| Posterior Region | | | | | |
| Bite Wing | | | | | |

| ***CHILDREN*** | kVp | mA | TIME | Source to Skin Distance | FILM Type and size |
|---|---|---|---|---|---|
| Anterior Region | | | | | |
| Posterior Region | | | | | |
| Bite Wing | | | | | |

Note: The "source" is the focal spot location within the tube head and is marked on the head assembly.

SSD = Source to Skin Distance at the cone tip SID = Source to Image receptor Distance at the film

# Appendix D

## Personal Dosimeter Suppliers

Monitoring devices may be obtained from:

| | | |
|---|---|---|
| ICN Dosimetry Service | Landauer, Inc | Quantum Products |
| 800-251-3331 | 800-323-8830 | 800-359-9686 |

# Appendix E

## Film Processor Testing Procedures

Check processor chemistry activity at least once a week using a density comparison technique, such as the Crabtree®* device or a density step wedge such as the 76-025-4000 Dental Aluminum Step Wedge from Inovision/Nuclear Associates**.

The Crabtree® device is a density comparison tool that is constructed with copper strips to create density "steps" on a dental intra oral film. The film is inserted into the pocket on the device and exposed to x-ray. A "master" film is created when the chemistry is fresh and retained. A new "master" is created each time the chemistry is changed. This master is used to compare with the weekly test film.

a. The processed image is compared to a density scale to determine whether there are changes in the density or contrast due to changes in the chemistry. Lighter films could indicate developer that is getting exhausted and needs to be changed or replenished.
b. By testing at least once per week, you may be able to extend the chemistry change time and save resources by not changing as frequently.
c. You may find that the automatic replenishment system (if the unit has one) is not functioning properly and you need to hand replenish the developer.
d. Films that are cloudy may indicate that the fixer solution has become contaminated and needs to be changed or replenished.
e. If the difference between the "master" film created when the chemistry was fresh and the weekly comparison film is one step or more when comparing the same step, the chemistry needs to be changed or replenished.

**Large film processors (ceph and pan)**

a. If a large film processor is used for ceph or pan films, the 11 step aluminum wedge, such as the Nuclear Associates Model 76-025-4000, may be used with a flat cassette such as a cephalometric cassette. If the cassette has a screen block for the nasal bones, be sure to place the wedge on the portion of the cassette where the screen in not blocked.
b. If only a curved cassette or flexible film holder for a pan unit is available, the test cannot be performed and you will have to rely on the processor manufacturer instruction for frequency of chemistry changes.
c. If a flat cassette is available, expose the wedge on the cassette to a technique of about 70 kV at about one second or 60 pulses. This can be done with the cassette in the ceph frame by taping the wedge to the cassette. This should produce a film that shows all 11 steps on the wedge. The darker steps (thinner portion of the wedge) may be difficult to discern.
d. Label the first film on fresh chemistry as the "master" and retain this film.
e. Compare all other films to the "master".
f. If the density difference between the "master" and the test film is more than one step, the chemistry needs to be changed or replenished if the temperature is correct.

The test film should be exposed using the same x-ray machine and same technique each time. This will provide more consistent results and prevent unnecessary chemistry changes.

**Hand processing**

a. Hand processing chemistry needs to be tested at least once a week using one of the above methods.
b. Proper processing time is critical with hand tanks and a timer is needed in the darkroom.
c. A stem-type thermometer should be in the developer tank to monitor the temperature.
d. Process the film for the length of time required by the developer temperature.
e. A time/temperature chart should be posted in the darkroom.

**Alternative Methods**

Alternative test methods, such as anatomical phantoms, may be used for consistency testing so long as they are capable of producing images of sufficient contrast variation to tell when the chemistry needs attention.

*A Crabtree© device is a tool used to compare the density of dental films exposed using the device to a standard film which comes with the device. A step wedge in the device creates a density gradient when the film is exposed to x-ray. The films taken at various times of the month can be compared to see if the chemistry is becoming exhausted and needs to be replaced. (The Crabtree© device is available by calling (970) 470-0859, website address www.xrayqc.com)).

Other density comparison devices, such as an aluminum step wedge, may be used as well. The wedge is placed on the film and exposed to the same technique from the same tube head each time. The films are processed and compared with the master film created when the processor chemistry is first replaced. The master film is stored and used for the weekly comparison. A master film needs to be made each time the chemistry is changed.
**http://www.inovision.com/Nuclear_Associates/ Toll Free: 888.466.8257 may be contacted for the step wedge.

Caution: *Mention of a device, product or service does not constitute an endorsement by the department and serves only as a representation of the types of devices, products or services which are available*.

# Appendix F

## Hand Film Processing Time and Temperature Chart

The temperature of each solution shall be maintained within the range of 60 ºF to 80 ºF (16 ºC to 27 ºC). Film shall be developed in accordance with the time-temperature relationships specified by the film manufacturer or, in the absence of such recommendations by the film manufacturer, with the following time temperature chart:

**TIME-TEMPERATURE CHART**

**Thermometer Reading Minimum Immersion Time in the Developer**

| ºC | ºF | minutes |
|---|---|---|
| 26.7 | 80 | 2 |
| 26.1 | 79 | 2 |
| 25.6 | 78 | 2 ½ |
| 25.0 | 77 | 2 ½ |
| 24.4 | 76 | 3 |
| 23.9 | 75 | 3 |
| 23.3 | 74 | 3 ½ |
| 22.8 | 73 | 3 ½ |
| 22.2 | 72 | 4 |
| 21.7 | 71 | 4 |
| 21.1 | 70 | 4 ½ |
| 20.6 | 69 | 4 ½ |
| 20.0 | 68 | 5 |
| 19.4 | 67 | 5 ½ |
| 18.9 | 66 | 5 ½ |
| 18.3 | 65 | 6 |
| 17.8 | 64 | 6 ½ |
| 17.2 | 63 | 7 |
| 16.7 | 62 | 8 |
| 16.1 | 61 | 8 ½ |
| 15.6 | 60 | 9 ½ |

The non-mercury thermometer shall Indicate the actual temperature of the developer to within +/- 0.5 $^{0}$F

The timer shall signal the passage of a preset time as short as two minutes.

Film should be rinsed between the developer and fixer.

Immersion time in the fixer is usually twice that of the developer

A minimum of 15 minutes in flowing water is required for proper washing

| Make | Model | Transport time | Adjustable transport time? | Temp ($^0$F) | Temp Adjustable? | Recommended Chemistry | Change Solutions | Replenish Solutions | Film Sizes |
|---|---|---|---|---|---|---|---|---|---|
| Air Techniques | Peri Pro | 7 | No | Room (70-80$^0$) | No | Peri Pro | 2 Wks or 300-350 films | Daily | Intra-oral |
| Air Techniques | Peri Pro II | 6.25 | No | 75 | Yes | Peri Pro | As above | As Above | Intra-oral |
| Air Techniques | Peri Pro III | 5 | No | 75 | No | Peri Pro | As above | As above | Intra-oral, panoramic |
| Air Techniques | All Pro | 5 | No | 80 | Yes[3] | Air Tech | 3-4 Weeks[4] | Dly/90 films | Intra-oral, panoramic |
| Air Techniques | AT 2000 | 2.0-6.5 | Yes | 82 | Yes | Air Tech | 3-4 Wks | Auto | All |
| Air Techniques | AT 2000+, AT 2000XR | 2.0-6.5, 5.5 recommended | Yes | 82 | Yes | Air Tech | 3-4 Wks | Auto | All |
| AFP(Dent-X) | 8DE | 2-7 | Yes | 86 | Yes | RP | Monthly | Auto | All |
| Dent-X | 9000 | 2, 4.5, 6[5] | Yes | 83 | Yes | Dent-X | Monthly | Auto | All |
| Dent-X(Philips) | 810, 810XL, 810 Basic | 2, 4.5, 6 | Yes | 83 | Yes[7] | Monthly | Monthly | Daily[8] | All |
| Dent-X(Philips) | 410 | 6.5 | Yes | 83 | Yes | Dent-X | Monthly | Daily | Intra-oral |
| Gendex | GXP | 2.5, 5.0 | No | 82 | No | Gendex | Monthly | Auto | All |
| Xonics, Litton,Hope | P4,6 | 4.3 | No | 80 | Yes[9] | Xonics A&B Auto | Monthly | Daily/Auto | P4:Intra-oral only<br>P6 Intra, Pan |
| Xonics, Litton, Hope | P10 | 4.3 | No | 80 | Yes[10] | Xonics A&B | 2-4 Weeks | Button Type; 1 push/8 films | All |
| Velopex | Intra-X | 4.0 | No | 77 | Yes | Velopex | 2 Wks | Daily | Intra-oral |
| Velopex | Extra-X | 4.0 | No | 79 | Yes | Velopex | Monthly | Auto | All |

3. Screw at back of machine next to plugs and name plate

4. Manual Replenishment change = 3 wks. Optional auto replenishment change = 1 month

5. Two minutes for Endo, 4.5 min normal, 6.0 min when processor is warming up

6. Front knob of time/temp control

7. Front (screw) of time/temp control

8. Six ounces each morning and another six ounces if heavy volume

9. Screw next to light at bottom of processor, feed end

10. Under dryer assembly (lifts off). Thermostat control to right of fuse and developer light